Application #09/467,721
Submitted May 30, 2006
Reply to Office Action of November 29, 2005

II. IN THE SPECIFICATION

A. CROSS-REFERENCE TO RELATED APPLICATIONS

5. In the second paragraph on page 1, change:

'to be known as the "RHN" algorithm'

to

–known as the "RHN" algorithm, now United States Patent 7,016,417–

III. INTRODUCTION

6. The Office Action dated November 29, 2005 has been carefully considered. Reconsideration of this application, in view of the following remarks, is respectfully requested.

B. References

7. The following U.S. patents were relied on in the office action:

- US Patent 6,058,215 ("Schwartz"), filed April 30, 1997.
- US Patent 6,384,862 B1 ("Brusewitz") filed May 7, 2002.
- US Patent 6,574,278 B1 ("McVeigh"), filed June 3, 2003
- US Patent 4,743,959 ("Frederiksen"), filed September 17, 1986.

C. Overview of Office Action

8. The office action:

a) Rejected claims 11-12, 14-15 as being obvious in light of Schwartz in combination with Brusewitz and McVeigh under 35 U.S.C. 103(a).

b) Rejected claim 13 as being obvious in further light of Frederiksen under 35 U.S.C. 103(a).

D. Claim Rejections under 35 U.S.C. 103(a)

9. The office action rejected claims 11-12 and 14-15 as being obvious in light of Schwartz in combination with Brusewitz and McVeigh under 35 U.S.C. 103(a). Claim 13 is rejected in further view of Frederiksen under 35 U.S.C. 103(a).

IV. ISSUE OF APPLICANT'S "RHN" PATENT

E. Applicant's US Patent 7,016,417

10. Please take note that United States Patent 7,016,417, Román, et al., entitled "General purpose compression for video images (RHN)", issued on March 21, 2006. The RHN patent issued over Bruzewitz and Fredericksen. The present invention has common inventorship and ownership.

11. Figures 5A to 5C of this application show formats from the RHN invention. Figure 7 of this application shows coding and encoded stream from the RHN invention. This application is an improvement over the RHN invention, which has been found to be patentable over the some of the currently cited art as well as many other DCT-based patents. The improvement relates to a more efficient encoded data format over the RHN format, which incorporated a bit to indicate whether or not the an element of the encoded data was a data field or a run-length field. In the present invention a run-length is always included with a data field in each element of encoded data. Note that neither RHN nor the present format is the same as convention zero run-length encoding, as will be discussed in more detail below.

12. Both RHN and the present invention are distinguished over the prior art in part because of the bit sub-sampling of each pixel while scanning and then run length encoding the resulting value. The difference between RHN and the present invention is the that the present invention improves the efficiencies of the format of the encoded data and broadens the novel approach started by RHN to make it variably applicable to different needs, as indicated by the name "VARIABLE GENERAL PURPOSE COMPRESSION FOR VIDEO IMAGES"

13. Note that claim 17 of U.S. Patent 7,016,417 claims a machine which includes an encoding circuit of claim 1, which an encoding circuit which is distinguished over

block-based, DCT-based systems which, unlike the present invention, do not teach "bit sub-sampling" and run-length encoded of non-zero values.

V. IN THE SPECIFICATION

F. CROSS-REFERENCE TO RELATED APPLICATIONS

14. In the second paragraph on page 1, change

'to be known as the "RHN" algorithm' to

–known as the "RHN" algorithm, now United States Patent 7,016,417–

VI. IN THE CLAIMS

G. Claim 11

15. Claim 11 has been amended to clearly point out that the data value can include zero (as well as non-zero values) and the run-length is not always a run of zero values but is a run-length of the specified data value which may be zero or non-zero.

VII. DISCUSSION OF NEW GROUNDS–MCVEIGH

H. McVeigh Basis of New Grounds

16. The office action added McVeigh to previously argued combinations to suggest the obviousness of claims 11. Specifically, the office action relies on McVeigh, stating "McVeigh et al teaches subsampling block of image data (Fig. 6, 604) and an entrophy encoding process (Fig. 5, 514) comprising outputting *a series of encoded data comprising a combined run-length field (runs of zeros) and a data field (non-zero value)*, known as run-length encoding (col. 7, lines 44-59) for fast, simple, and a more efficient way to encode image data".

I. McVeigh Misunderstood

17. The office action misunderstands McVeigh; it does not teach what the examiner relies upon it as supposedly teaching. McVeigh teaches "image sub-sampling" not "bit

sub-sampling" (see chart below). Further, McVeigh teaches conventional run length encoded of runs of zeros and a data field that is a non-zero value. This is not what applicant's invention teaches or claims. The current amendment to claim 11 more clearly makes this distinction.

18. For example, the lower part of Fig 6 explicitly shows an illustrative example with three encoded data elements 640 (i.e. 650, 653, 656) with data fields (651, 654, 657) have a decimal value of 0, 2, and 10, respectively. Thus the data field can have a zero value and the count field can count, zeros, twos, tens or any other value. This is not what McVeigh is teaching.

19. McVeigh states, "Since the quantized DCT coefficients in the right half of the 8x8 block are always zero…an [zero] run-length encoding provides the most efficient entropy encoding process… the goal is to maximize the run of zeroes for maximum compression efficiency." In this way McViegh and the other block-based, DCT-based references teach away from the present invention. The present invention does not run length encode quantized DCT coefficients, but instead sub-samples bits and run length encodes the resulting data values (whether zero or not).

20. Thus, the present invention departs from the block based, DCT-based methods of the cited art and takes a new direction. The DCT-based methods are designed to create runs of zeros, applicant's invention does not, and therefore, convention run-length code is not advantageous.

21. The following table outlines the different types of subsampling that have been distinguished so far during prosecution of this application.

Frame Subsampling	Selection a subset of frames (or images) in a series of video frames
Image Subsampling	Selection of a subset of pixels from an array of pixels that make up a single frame, by skipping pixels in a row or by skipping rows. **(Brusewitz, McViegh)**
Area Subsampling	Selection of a subset of pixels from the array of pixels that make up a single frame, by selecting sub-area that has either a width or height less than the original image, but without any skipping pixels in that sub-area
Bit Subsampling	Selection of a subset number of bits from each pixel **(Applicant's claim 11)**.

22. The sub-sampling taught by the prior art, such as Brusewitz and McViegh, is image sub-sampling which is distinct from bit sub-sampling. Applicant's invention may be distinguished over the proposed combination of Schwartz, Brusewitz, and McVeigh, by the existing language of claim 11, namely, "a pixel value comprising a number of pixel bits sub-sampled from each pixel when scanning said plurality of pixels".

J. McVeigh Adds No New Teaching to the Combination of Schwartz and Brusewitz

23. Schwartz and Brusewitz already teach applying:

- DCT (e.g. Schwartz Fig 1B 122),
- Quantization (e.g. Schwartz Fig 1B 127), and
- Run-length encoding the zeros in the quantized coefficients (e.g. Schwartz Fig 1B 124)
- Schwartz and Brusewitz already teach applying:

24. Thus McVeigh adds nothing new to the proposed combination.

K. Support Still Lacking for Bit Sub-sampling from Each Pixel

25. The office actions acknowledges that:

- "Schwartz et al does not specifically disclose counting repeated instances of a pixel value comprising a number pixel bits sub-sampled from each pixel when scanning a plurality of pixels." (page 3, paragraph 2, emphasis in office action)

As discussed above:

26. However, as discussed above Brusewitz, fails to show "bit sub-sampling for each pixel when scanning", instead the subsampler 18 of Brusewitz shows "image subsampling." "The subsampler 18 determines pixel values representing the captured video image at a particular spatial resolution, i.e., pixels per line and lines per image..." (Bruzewitz column 1, lines 45-49).

27. Thus, there has not been a clear showing of prior art that would render obvious claim 11's limitation of "a pixel value comprising a number of pixel bits sub-sampled from each pixel when scanning said plurality of pixels".

VIII. DISCUSSION OF RUN-LENGTH ENCODING

L. Conventional Run Length Encoding

28. The office action notes that "conventionally run-length encoding (RLE) consists of strings of bits as a number indicating the length of a series of zeros, followed by a non-zero element, and repeats 'til end." (emphasis in office action). This is one type of run-length encoding, where only runs of zeros are encoded with a run length and non-zero values stored as is. Note that Schwartz teaches this type of run-length encoding, namely, numeral 124, which is labeled "Runlengths of zeros".

29. Applicant further acknowledges that other types of run length encoding were known in the art. The Oxford Dictionary of Computing (1996) defines run-length encoding

as "A lossless compression technique where a sequence of pixels with the same value is replaced by a value and a count." The specification also distinguishes the present invention over the RHN format and method of run length encoding, discussed in reference to Fig 5B, 5C, and 7.

M. Fig 6 Not Limited to Run-Length Encoding of Zero Values

30. Although Fig 6 shows an example of zero values being repeated, the method of the present invention is not limited repeating zero values. Note that each code has as data field and a count field, "each containing a merged value and count, (651, 652), (654, 655), and (657, 658), respectively". In Applicant's invention when a value of "2" is repeated more than once, the sequence is encoded with a value and a count. If the data (620, 622, 624, 626 and 628) had been 2, 2, 2, 2, and 2, respectively, the first byte 650 of encoded data would have the binary value of 00010 in 651 and 101 in 652.

31. Applicant's run-length encoding element can be distinguished from conventional run length of zeros encoding in that each sequence of data values will be encoded regardless of whether the data value is zero or non-zero.

N. Crowded Art—Small Step Forward

32. As evidenced by the many references cited in this case, the area of image compression is one of crowded art. There are many types of compression, each using different combinations of various techniques, with many patentable distinctions. Differences in run length encoding formats have even been found to be patentable. Applicant submits, that like RHN's improved run-length encoding, the present invention's small step forward, with improvement in data reduction over RHN, should be found patentable.

IX. DETAILED ANALYSIS OF PRIOR ART

33. In the following detailed analysis, the distinctions between the elements of the prior art and of the Applicant's invention will be discussed. When individual elements are combined, the combination suggested by the Office Action fails to suggest the subject mater of the pending claims. The subject matter of Applicant's invention as a whole would not have been obvious.

O. Schwartz Does Not Teach Elements Referred to by the Office Action

34. The office action fails to present a clear argument why the claimed subject matter as a whole would have been obvious. Regarding claims 11, 14, and 15, the office action cites Schwartz teaching:

- A video digitizer at col 5, lines 5-8, for digitizing a frame from the video frames
- A video memory for receiving a plurality of pixels (col. 5, lines 3-5)
- An encoding circuit (Fig 1B) for sub-sampling from each pixel (121) when scanning the plurality of pixels and outputting a series of encoded data comprising a combined run-length (run) field and a data (length) field, know as run-length encoding (124) and
- a memory for storing encoded data and an input/output devices, which are storage medium and a communications transmission channel (Fig. 1B, Channel/storage).

35. The same references are also used in combination to reject claims 12 and 13.

P. Schwartz Fails Teach What is Relied on by the Office Action

36. The citations do not teach what the office action relies on for the combination to teach.

Q. Schwartz Fig 1B Does Not Teach Applicant's Encoding Circuit

37. Schwartz Fig 1B shows an encoding circuit composed of seven steps. The reference does not teach what the Office Action relies upon it as supposedly teaching. Schwartz does not clearly teach "a pixel value comprising a number of pixel bits sub-sampled from each pixel", rather Schwartz merely teaches "color space or subsampling block 121 which performs color space conversion or subsampling of the input data." (Schwartz 5:37-40) This does not clearly teach the required limitation of "a pixel value comprising a number of pixel bits sub-sampled from each pixel". One of ordinary skill in the art would have understood this to refer to color space conversion from RGB to YCbCr where the resolution of the two chrominance components Cb and Cr is reduced, such as taught by Frederiksen where "a pair of chrominance components (R-Y) [Cr] and (B-Y)[Cb] for every four horizontal pixels in the image" is "then averaged so that a block is finally represented by two pairs of chrominance components" (Federiksen 5:64-6:13). This is not the same as subsampling a number of pixel bits for each pixel.

38. Further, Schwartz does not teach "outputting a series of encoded data comprising a combined run-length field and a data field". The Office Action cites reference numeral 124, which is labeled "Runlengths of zeros" and is described as "run length block 124 which identifies run lengths of zeros. The output of run length block 124 is coupled to the input of Huffman coder 125, which performs Huffman coding." (Schwartz 5:48-52). This is not the same as Applicant's encoded data that has a run-length field and a data field. In Schwartz because the run-lengths are of zeros there is no need to have a data field. In this regard, Schwartz teaches away from the present invention. Further, Schwartz teaches a Huffman coding step that occurs prior to outputting the encoded data. Further, applicant's invention omits many

elements of Schwartz's compressor (namely, block averaging, the Discrete Cosine Transform (DCT), quantization, zig-zag, Huffman coding, and signaling), thus Applicant's invention is made simpler.

R. The Combination of Schwartz, Brusewitz and McVeigh Does Not Teach Applicant's Encoding Circuit

39. The Office Action admits that Schwartz does not specifically disclose counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled, and relies on Brusewitz and McVeigh to teach the missing element. However, as discussed above, neither Bruzewitz nor McVeigh teach the missing element.

S. The Combination of Schwartz, Brusewitz and McVeigh is Improper

40. Schwartz, Brusewitz and McVeigh do not individually contain any suggestion that they be combined, especially in the manner suggested. Further, the references are individually complete so there would be no reason to use parts from or to add or substitute parts to any reference. The references take different overall approaches to solving the compression problem; since they teach away from each other, it would not be logical to combine them. Further, as discussed above, the references teach away from the suggested combination.

41. Finally, even if the Schwartz, Brusewitz and McVeigh were combined as suggested, the combination would not meet the limitations of the claims, such as "counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled from each pixel" or "encoded data comprising a combined run-length field and a data field" as required by claim 11(c), as discussed above. Thus, the combination still lacks the claimed feature.

T. Applicant's Invention

42. Applicant's invention is a simple, fast, effective, on-the-fly, one-pass, clinically lossless way of compressing a video signal. As pixels are digitized and received into a video memory, the present invention is able to extract a pixel value by sub-sampling a predetermined number of bits from each pixel, and then count repeated instances of that bit-wise sub-sampled value. The encoding circuit is able to do this in one pass, on-the-fly, "when scanning" and outputs a data code for each run of extracted pixel values. While not a limitation of claim 11 as currently amended, an embodiment of this invention could hypothetically output encoded data as soon as two or more pixels were digitized. This is much different than the methods and apparatus taught by the cited references, performs many different steps and takes different approaches. The present invention eliminates many steps found in the cited art and is able to provide clinically lossless results that cannot be achieved by the prior art.

U. Claims 11, 14, and 15 Not Rendered Obvious by Schwartz, Brusewitz and McVeigh

43. As discussed above, neither Schwartz, Brusewitz, McVeigh, nor their combination teach the elements of the present invention. Neither Schwartz, Brusewitz or McVeigh suggested combination teach "an encoding circuit for counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled from each pixel when scanning said plurality of pixels and outputting a series of encoded data comprising a combined run-length field and a data field" as required by claim 11(c).

44. Further, Schwartz, Brusewitz and McVeigh teach away from counting repeated instances of a bit-wise sub-sampled value when scanning. The present invention omits many elements of the cited prior art, makes compression faster and simpler and results in

superior image quality. The present invention goes against the grain of prevailing discrete cosign transform (DCT) compression techniques taught by the prior art. Products incorporating the present invention have been licensed and used by hospitals in the University of California system. The present invention provides many unexpected results or unappreciated advantages over the prior art as outlined in the "Objects and Advantages" section of the specification. Thus, neither Schwartz, Bruzewitz, McViegh, nor their combination, render the claims obvious.

V. Claims 12 Not Rendered Obvious

45. Claim 12 is a dependent claim, and, for all the reasons stated above with respect to independent claim 11, should be patentable over Schwartz in combination with the other references.

W. Claims 13 Not Made Obvious by Schwartz, Brusewitz, McVeigh and Frederiksen

46. Claim 13 is a dependent claim, and, for all the reasons stated above with respect to independent claim 11, should be patentable over the suggested combination of Schwartz, Brusewitz, McVeigh, and Frederickson. (Note: applicant is unclear regarding the reference to Bobick, and, for purposes of this response, has assumed that reference to Bobick were intended to mean McVeigh).

47. Frederiksen does not teach "a pixel value comprising a number of pixel bits sub-sampled <u>from each pixel</u>" (claim 11(c)) "wherein said pixel value is extracted from the most significant bits of each color component" (claim 13). Instead, Frederiksen teaches a <u>median</u> luminance value (derived from a <u>plurality of pixels</u>) and <u>average</u> chrominance values (also derived from a <u>plurality of pixels</u>) (see, Frederiksen 7:58-62).

48. Frederiksen teaches block-based encryption. Fig 2a shows the image with blocks of pixels. Fig 2 includes block based steps (e.g. 101, 102, 103). Fig 6 (802) states "apply block encoding procedure." Because Frederiksen (and the proposed combination) is block-based it cannot perform bit-subsampling "while scanning" as required by claim 13. Even if Frederiksen were combined with Schwartz, Brusewitz, McVeigh, the combined teachings would still not meet the limitations as set forth in claim 13 (and claim 11 upon which it depends). It would still require a modification not suggested by any of the references.

49. As stated above, Schwartz, Brusewitz and McVeigh do not teach bit-wise sub-sampling to extract a subset of bits as the pixel value. Because Schwartz, Brusewitz and McVeigh do not teach extraction of a smaller number of bits, it would not be obvious to combine Frederiksen's extraction of the most significant bits of each color component with Schwartz, Brusewitz, and McVeigh. There is no teaching or motivation to combine. All three references are complete in themselves and take mutually exclusive paths. Further, Frederiksen was published in 1988 and was available to each of Schwartz, Brusewitz and McVeigh, yet none chose to adopt Frederiksen's approach. Even if the references were combined, the combination would not result in Applicant's invention. The resulting combination would still take a much different, conventional approach to video compression, would include many elements omitted by the present invention, and would not have the resulting clinically lossless quality of the present invention. Thus, Schwartz and Brusewitz in view of Frederiksen do not render claim 13 obvious.

VII. AMONG CROWDED ART, APPLICANT'S INVENTION PROVIDES A NEW PRINCIPLE OF OPERATION

50. As can be seen by the many references cited and overcome to date in this application, there is crowded art where even small steps in the area of block transform based